A NEW TWO-TOED SKINK FROM EASTERN AUSTRALIA

G.J. INGRAM, P.J. COUPER AND S.C. DONNELLAN

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Lerista emmotti sp.nov. has been confused with *L. punctatovittata* (Günther, 1867). However, it differs from *L. punctatovittata* in the state of the forelimb (distinctly didactyle vs monodactyle or monostylus). As well, it can be distinguished by estimates of genetic distance derived from allozyme electrophoresis. □ *Scincidae, Lerista emmotti, Lerista punctatovittata, new species, electrophoresis, Australia.*

Glen Ingram & Patrick Couper, Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101, Australia; Steve Donnellan, Evolutionary Biology Unit, South Australian Museum, North Terrace, Adelaide, South Australia 5000, Australia; 30 April, 1993.

When Couper & Ingram (1992) described *Lerista colliveri*, they were aware of another probable species of *Lerista* that had been confused with *L. punctatovittata*. It differed in the state of the forelimb (distinctly didactyle vs monodactyle or monostylus). However, no other morphological characteristics that differentiated them were found. As well, the different states of the limb did not appear to be a good enough reason to describe a new species. Degenerate-limbed skinks may vary in the extent of development of the toes, and the different conditions are more valuable in the study of embryology than as characters for differentiating taxa. However, subsequent work by one of us (SCD) showed that the two-toed individuals could be distinguished by estimates of genetic distance derived from allozyme electrophoresis.

Queensland Museum's specimens are prefixed by QMJ, Australian Museum's by AMR and South Australian Museum's by SAMAR.

ELECTROPHORESIS

Materials and Methods

Twenty-seven '*Lerista punctatovittata*' were collected from 11 localities in Queensland, New South Wales and South Australia. Livers were dissected from fresh specimens and stored at -80°C until use. For the genetic analysis, specimens from a single locality which showed all the expected genotypes at each locus were treated as a population of a single genetic type. On this basis, 11 populations were designated:

Noon – Noonbah Station, Qld (24°07'S, 143°11'E) (QMJ54144-6);

Ston – Waterloo Station, via Stonehenge, Qld (24°16'E, 143°17') (QMJ56312-4);

Kaka – Ka Ka Mundi, Qld (24°49'E, 147°24'S) (QMJ56090);

Nyma – Nymagee, NSW (32°01'E, 146°20S) (SAMAR33548-50/552-7);

Mtho – Mt Hope, NSW (32°51'E, 145°53'S) (SAMAR33522);

Chow – Chowilla, SA (33°56'E, 140°59'E) (SAMAR32991-2, 33003);

Poog – Pooginook CP, SA (34°04'E, 140°07'S) (SAMAR38345/352);

Waik – 2km S Waikerie, SA (34°12'E, 140°01'S) (SAMAR39731);

Broo – Brookfield CP, SA (34°19'E, 139°30'S) (SAMAR36974);

Wida – 11km S Widara HS, SA (34°20'E, 139°57'S) (SAMAR38442)

Boon – 4.5km E Boongalechie, SA (34°27;'S, 139°26'E) (SAMAR39267).

Homogenates of liver were electrophoresed on sheets of cellulose acetate (Cellogel: Chemetron) as described by Richardson et al. (1986), and were assayed for 35 enzymes which were encoded by 40 presumptive loci. The enzymes stained, E.C. numbers and abbreviations (Murphy et al., 1990) are: aspartate aminotransferase (AAT, E.C. 2.6.1.1), aconitate hydratase (ACOH, E.C. 4.2.1.3), aminoacylase (ACYC, E.C. 3.5.1.14), alcohol dehydrogenase (ADH, E.C. 1.1.1.1), adenylate kinase (AK, E.C. 2.7.4.3), alanine aminotransferase (ALAT, E.C. 2.6.1.2), carbonate dehydratase (CA, E.C. 4.2.1.1), leucine aminopeptidase (CAP, E.C. 3.4.11.1), enolase (ENO, E.C. 4.2.1.11), fructose-diphosphatase (FBP, E.C. 3.1.3.11), fumarate hydratase (FUMH, E.C.4.2.1.2), glyceraldehyde-phosphate dehydrogenase (GAPDH, E.C. 1.2.1.2), guanine deaminase (GDA, E.C. 3.5.4.3), glycerol-3-phosphate dehydrogenase (G3PDH, E.C. 1.1.1.8), glucose-6-phosphate dehydrogenase (G6PDH, E.C. 1.1.1.49), glucose-phosphate isomerase (GPI, E.C. 5.3.1.9), glutathione reductase (GR, E.C. 1.6.4.2), glutamate dehydrogenase (GTDH, E.C. 1.4.1.3), L-iditol dehydrogenase (IDDH, E.C. 1.1.1.14), isocitrate dehydrogenase (IDH, E.C.

TABLE 1. Electromorph frequencies, expressed as a percentage, in 11 populations of '*Lerista punctatovittata*' at 40 loci. Electromorphs are designated alphabetically, with 'a' being the most cathodally migrating electromorph. Where enzymes are encoded by more than one locus, the loci are designated numerically in order of increasing electrophoretic mobility. Where the electromorph frequencies are not given, the frequency is 100. See 'Material and Methods' for an explanation of the population codes. The number of individuals sampled from each population is given under each locus. The following loci were invariant: *Aat-1, Aat-2, Acoh-1, Acyc, Adh, Ak-1, Ak-2, Ca, Cap, Eno, Fumh, Gapdh, Gda, G3pdh, Gpi, Gtdh,Iddh, Ldh-1, Ldh-2, Lgl, Mdh- 1, Mdh-2, Mpi, Pgam, Pk* and *Sod*.

LOCUS	STON	NOON	KAKA	MTHO	NYMA	CHOW	BROO	POOG	WIDA	BOON	WAIK
Acoh-2	e(50)	f(33)	d	d	d	d	d	d	d	d	d
	a(50)	c(17)									
		b(33)									
		a(17)									
	3	3	1	1	10	3	1	2	1	1	1
Alat	b	a	a	a	a	a	a	a	a	a	a
	2	3	1	1	10	3	1	2	1	1	1
Fbp	a	a	a	b	b	b	b	b	b	b	b
	3	3	1	1	10	3	1	2	1	1	1
G6pdh	b(17)	b(33)	a	a	a	a	a	a	a	a	a
	a(83)	a(67)									
	3	3	1	1	10	3	1	2	1	1	1
Gr	a	b(50)	a	-	a	a	a	a	a	-	a
		a(50)									
	2	2	1	0	10	3	1	2	1		1
Idh	a	b(33)	a	b	b(35)	b(50)	b	b(50)	b	b	b(50)
		a(67)			a(65)	a(50)		a(50)			a(50)
	1	3	1	1	10	3	1	2	1	1	1
Mdhp	a	a	a	b	b(85)	b(67)	b(50)	b	b	b	b
					a(15)	a(33)	a(50)				
	3	3	1	1	10	3	1	1	1	1	1
PepA	b	b(50)	b	b	b(80)	b	b	b(75)	b	b	b
		a(50)			a(20)			a(25)			
	3	3	1	1	10	3	1	2	1	1	1
PepB	c(33)	b	b	b(50)	b	b(83)	b(50)	b	a	b(50)	b(50)
	b(67)			a(50)		a(17)	a(50)			a(50)	a(50)
	3	3	1	1	10	3	1	2	1	1	1
PepD	a	b	a	a	a	a	-	a	a	a	a
	3	2	1	1	10	3		1	1	1	1
Pgdh	b	a	b	b	b	b	-	b	b	b	b
	3	3	1	1	10	3		1	1	1	1
Pgm-1	a	b(67)	b	b	b(61)	b(67)	b(50)	b(50)	a	b(50)	b(50)
		a(33)			a(39)	a(33)	a(50)	a(50)		a(50)	a(50)
	3	3	1	1	9	3	1	1	1	1	1
Pgm-2	a	a	b(50)	a	a	a	a	a	a	a	a
			a(50)								
	3	3	1	1	10	3	1	2	1	1	1
Tpi	a	a	a	a	a	a	a	a	b(50)	a	a
									a(50)		
	3	3	1	1	10	3	1	2	1	1	1

1.1.1.42), lactate dehydrogenase (LDH, E.C. 1.1.1.27), lactoyl-glutathione lyase (LGL, E.C. 4.4.1.5), malate dehydrogenase (MDH, E.C. 1.1.1.37), 'malic' enzyme (MDHP, E.C. 1.1.1.40), mannose-phosphate isomerase (MPI, E.C. 5.3.1.8), peptidases (PEP, E.C. 3.4.11 or 13.*), phosphoglycerate mutase (PGAM, E.C. 5.4.2.1), 6-phosphogluconate dehydrogenase (PGDH, E.C. 1.1.1.44), phosphoglucomutase (PGM, E.C. 2.7.5.1), pyruvate kinase (PK, E.C. 2.7.1.40), superoxide dismutase (SOD, E.C. 1.15.1.1), and triose-phosphate isomerase (TPI, E.C. 5.3.1.1). Electromorphs were identified by comparison with samples that were repeatedly included on each gel (internal controls) and through critical side-by-side comparisons (line-ups; see Richardson et al., 1986).

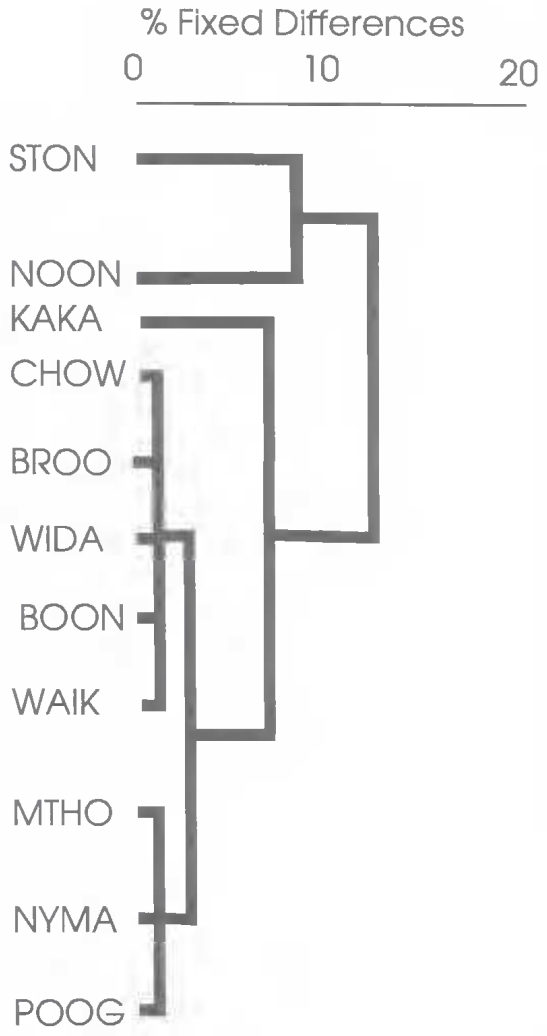

FIG. 1. Phenogram of the percentage fixed differences between populations, constructed by the unpaired group method of analysis (UPGMA).

RESULTS

Electromorph distributions at the 40 loci resolved are shown in Table 1. These data were converted into a matrix of percentages of loci showing fixed differences between populations (Table 2). A fixed difference occurs at a locus when the two populations being compared share no electromorphs (Richardson et al., 1986). Figure 1 is a phenogram of the percentage fixed differences between populations, constructed by the unpaired group method of analysis (UPGMA). The phenogram is not intended to reflect phylogenetic relationships, but rather to give a visual indication of the genetic diversity and genetic distances between the 11 populations. The specimens fell into three major genetic groups: 1, Stonehenge; 2, Noonbah; and 3, Ka Ka Mundi and the populations from NSW/SA.

The Stonehenge and Noonbah populations are regionally sympatric (separated by 15km) and have fixed differences at 3 loci (*Gpt, PepD* and *Pgdh*). The Ka Ka Mundi/NSW/SA populations have fixed differences with Stonehenge and Noonbah at a minimum of 3 (*Acoh-2, Alat* and *Fbp*) and 2 loci (*Acoh-2* and *Fbp*; *PepD* and *Pgdh* not scored in Brookfield population) respectively. Within the Ka Ka Mundi/NSW/SA group, Ka Ka Mundi has a single fixed difference (*Fbp*) with the NSW/SA populations.

From the preceding electrophoretic analysis, the Noonbah population is clearly distinct from the other populations. Morphologically, all the Noonbah specimens have a didactyl forelimb while the specimens from the other populations have a monodactyl or monostylar forelimb. The latter are identifiable with *L. punctatovittata* and the Noonbah specimens thus warrant recognition as members of a new species.

SYSTEMATICS

Lerista emmotti sp.nov.
(Figs 2-4)

1992 *Lerista punctatovittata* (in part); Cogger, 1992.

MATERIAL EXAMINED

HOLOTYPE: QMJ53959 Noonbah Stn, 140km S of Longreach (24°07'S, 143°11'E), CQ, A. Emmott, 2 September 1991.

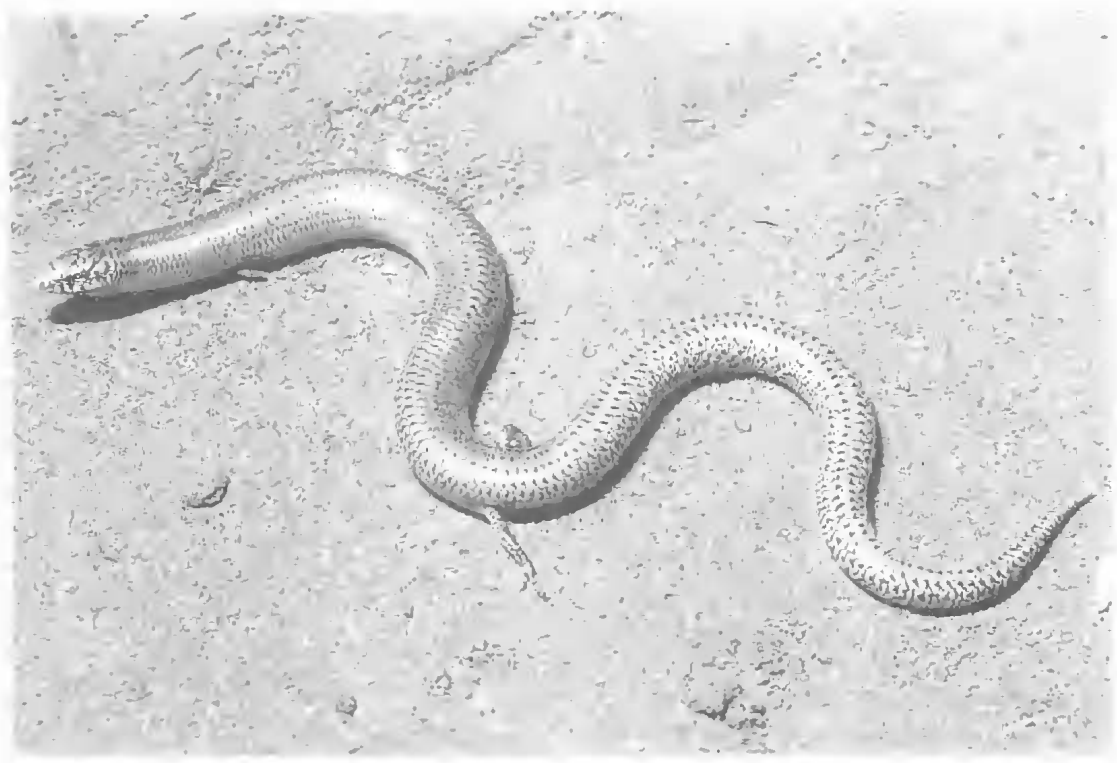

FIG. 2. *Lerista emmotti* sp.nov., paratype QMJ51630 in life, Noonbah Station, CQ (Steve Wilson).

PARATYPES: QMJ9038 Muttaburra (22°36'S, 144°33'E), CQ; QMJ54491-2 Hickleton Stn (24°02'S, 143°08'E), CQ; QMJ50066, 50068-69, 51217-8, 51629-30, 52585-7, 53958, 53960, 54144-6, 54292, 54493 Noonbah Stn (24°07', 143°11'), CQ;QMJ 51529, no data; AMR92302 Wooltana Homestead (30°25'E, 139°25'S), SA; AMR14682, Mootwingee Water Holes (31°17'E, 142°18'S), NSW; AMR114408 north end of Mungo Homestead airstrip, Mungo NP (33°43'S, 142°57'E), NSW; AMR114314 Old Arumpo Homestead (33°48'S, 142°53'S), NSW.

DIAGNOSIS

A large (maximum snout-vent length 103mm) *Lerista* with a movable eyelid and didactyl fore- and hindlimbs. A member of the *L. macropisthopus* species group (cf. Wilson & Knowles, 1988), of which the following members may also be didactyle on both fore- and hindlimbs: *L. gerrardii*, *L. neander* and *L. picturata*. *L. emmotti* is readily distinguished from *L. gerrardii* by pattern (broad black upper lateral stripe absent vs broad black upper lateral stripe present); from *L. nean-*

TABLE 2. Matrix of percentage fixed allelic differences between 11 populations of '*Lerista punctatovittata*'.

	STON	NOON	KAKA	MTHO	NYMA	CHOW	BROO	POOG	WIDA	BOON	WAIK
STON	-										
NOON	8	-									
KAKA	8	8	-								
MTHO	15	13	8	-							
NYMA	8	10	3	0	-						
CHOW	8	10	3	0	0	-					
BROO	13	7	7	0	0	0	-				
POOG	10	13	5	0	0	0	0	-			
WIDA	15	15	14	3	3	0	0	3	-		
BOON	14	14	8	0	0	0	0	0	0	-	
WAIK	10	13	5	0	0	0	0	0	0	0	-

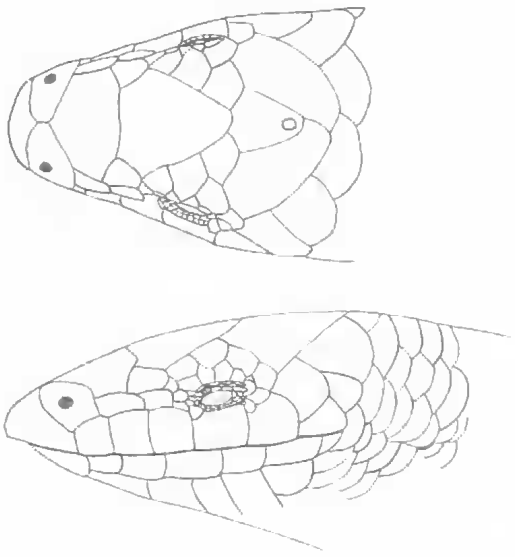

FIG. 3. *Lerista emmotti* sp.nov. (paratype QMJ51218). Above: dorsal view of head. Below: lateral view of head.

der by the number of supraciliaries (5 vs 3); from *L. picturata* by the number of supraciliaries (5 vs 1-3). *L. emmotti* most closely resembles *L. punctatovittata* but it can be separated from this species by the state of the forelimb (distinctly didactyle vs monodactyle or monostylus). *L. emmotti* is further distinguished from *L. punctatovittata* by the biochemical data in Table 1.

Description

Snout-vent length: 39-103mm (N 24, mean 72.6). Length of appendages etc. (% snout-vent length): forelimb 3-7 (N 24, mean 4.5), hindlimb 11-16 (N 24, mean 13.0), tail 87-122 (N 13, mean 105.2), head length 8-13 (N 24, mean 9.9), head width 6-9 (N 24, mean 6.9).

Nasal contact narrow (N 1) to moderate (N 20) to broad (N 5). Nostril positioned anteriorly to centrally on nasal scale. Rostral shield rounded in profile. Prefrontals small to moderate, widely spaced. Interparietal large and free. Frontoparietals narrowly (N 4) to moderately (N 22) spaced, smaller than interparietal. Parietals in narrow contact (N 1), moderate contact (N 3), broad contact (N 22). Enlarged nuchal scales 5-9 (N 14, mean 7.8), of which only two contact the parietals. Lower eyelid movable. Opaque disc occupying more than half the lower eyelid. Supraoculars 3, first two in contact with the frontal. Supraciliaries 5 (N 26). Loreals 2, second usually smaller. Presuboculars 2. Supralabials 6, fourth below eye. Infralabials 5-6 (N 26, mean 5.9). Primary temporals 1. Secondary temporals 2, lower smallest and overlapping upper. Ear aperture minute, overlapped by scales. Midbody scale rows 18, rarely 20 (N 26, mean 18.3). Paravertebral scales 78-90 (N 24, mean 85.5). Two enlarged preanal scales (N 25); right overlapping left (N 14), left overlapping right (N 11). Forelimb with two digits; both digits clawed (N 19), only one digit clawed (N 6), neither digit clawed (N 1). Hindlimb with two clawed digits, 2nd digit markedly longer than 1st. Lamellae under longest toe 9-12 (N 26, mean 10.6).

FIG. 4. Distribution of *Lerista emmotti* sp.nov. Numbers refer to populations of '*L. punctatovittata*' electrophoresed: 1, Noon; 2, Ston; 3, Kaka; 4, Nyma; 5, Mtho; 6, Chow; 7, Poog; 8, Waik; 9, Broo; 10, Wida; 11, Boon.

Dorsal and upper lateral ground colour tan to mid-brown with the each scale bearing a dark streak, which in turn form longitudinal lines of dark spots. Mid to lower lateral zone cream, marked by dark flecks. Venter either immaculate cream, or sometimes obscurely marked by dark-edged scales. Under surface of tail faintly to strongly patterned with dark flecks. Head shields dark-edged; lips barred; loreals and temporals marked by a dark streak which breaks up posteriorly.

DISTRIBUTION

From Muttaburra (22°36'E, 144°33'S), central Queensland, southwest to old Arumpo homestead, (33°48'E, 142°53'S), New South Wales. Also extending into South Australia (30°25'E, 139°25'S).

ETYMOLOGY

Named for Angus Emmott, naturalist and friend of the Queensland Museum.

REMARKS

Our examination of the holdings of the Queensland and Australian Museums showed '*L. punctatovittata*-like' *Lerista* with didactyl forelimbs to be confined to the western edge of the known distribution of *L. punctatovittata*. These specimens, described here as *L. emmotti*, are both morphologically and biochemically distinct from *L. punctatovittata*. However, monostylar individuals from central Queensland, which appear to be morphologically indistinguishable from *L. punctatovittata*, are biochemically distinct from the more easterly and southerly populations of this species.

Clearly, *L. punctatovittata* as currently recognised is a composite species. Unfortunately the locality given for the holotype is simply 'Queensland'. Although it is tempting to assume that this specimen was most likely collected from more coastal populations, such an assumption would be unsound because considerable settlement of western Queensland had taken place by the time *L. punctatovittata* (Günther, 1867) was described. The distribution of *L. punctatovittata* and the description of cryptic forms within this species complex warrant further investigation.

As well, even though we have assigned didactyl specimens from NSW/SA to *L. emmotti*, nevertheless the possibility remains that some populations of *L. punctatovittita* are polymorphic for the didacty-monodactyl condition. This possibility should be tested by further allozyme analysis.

The holotype of *L. punctatovittata* (Natural History Museum, London BMNH 1946.8.18.80; Cogger et al, 1983) has a monostylar forelimb (Boulenger, 1887) and is not a specimen of *L. emmotti*. Cogger et al. (1983) listed *Rhodona officeri* McCoy, 1881, as a junior synonym of *L. punctatovittata* and noted that the type material of *officeri* had not been located (see also Coventry, 1970). However, MeCoy's description and illustration of the holotype are detailed. The specimen agrees in all characteristics with *L. punctatovittata*, including having a monodactyl forelimb. We therefore concur with the synonymy of Cogger et al., (1983).

This study highlights the power of combining morphological character analysis with an independent genetic technique, such as allozyme electrophoresis, to assess the systematic significance of seemingly trivial morphological variation.

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